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Searching on the Campus? Marriage Market Effects of the Student Gender Composition by Field of Study

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Searching on the Campus? Marriage Market Effects of the Student Gender Composition by Field of Study

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Abstract

This paper studies marriage market effects of the student gender composition by field of study for German university graduates. Using Microcensus data combined with aggregate information on the male to female ratio of students, I exploit substantial variation in gender imbalances over the period 1977–2011 and by 41 fields of study experienced by highly educated individuals. The main findings show that a higher share of the own gender among fellow students negatively affects marriage market opportunities for women and decreases the probability of having a partner from the exact same field. Moreover, when students of the opposite sex are relatively scarce in the field men are more likely to marry down with respect to educational status, while women rather have a partner with the same level of education. The results are in line with social norms with respect to spouses' socio-economic status and show that the educational system is a crucial marriage market for high-skilled individuals. This may have important implications for the socio-demographic composition of societies.

JEL Classification: D10, I23, I24, J12

Keywords: marriage markets, sex ratio, higher education, Germany

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1 Introduction

Marriage market outcomes have important implications for labor supply, income inequality, fertility and intergenerational mobility. For high-skilled individuals, the educational system represents a crucial marriage market since enrollment in university education typically implies being faced with a homogeneous peer group of similar age and ability just before marrying age (Blossfeld and Timm, 2003).¹ A key parameter characterizing marriage market conditions for a given sub-population is the respective gender composition. An imbalanced sex ratio, i.e., the number of men relative to the number of women, typically favors the gender that is relatively scarce by reducing partner search costs (Mansour and McKinnish, 2014; Kaufmann et al., 2013) and increasing bargaining power (Chiappori et al., 2002; Angrist, 2002; Negrusa and Oreffice, 2010; Abramitzky et al., 2011). In many Western societies, the gender composition among university students has changed considerably over the past decades mainly due to substantial advancements in female attainment in higher education. In addition to having significantly improved labor market opportunities for women (Goldin et al., 2006), this secular trend may have altered marriage market prospects for both male and female graduates and is considered as an important driver of increasingly assortative mating among the high-skilled.²

The implications of changing marriage market conditions for couple formation can be expected to be shaped by social norms regarding the composition of couples with respect to socio-economic status. Bertrand et al. (2015) study the share of income earned by male and female spouses within the household. They show that the likelihood of deviating from *gender identity norms*, stipulating that the husband should be the main earner in the household, affects various socio-economic outcomes by reducing marriage rates, female labor supply and quality of marriage. This norm

¹ In Germany, individuals holding a university degree marry shortly after having completed education. On average, age at graduation is 28.1 (27.2) for men (women), while age at marriage is 30.0 (28.8) for men (women), i.e., the average time interval between graduation and marriage is less than two years. Individuals with lower levels of education finish education at much earlier age (men: 22.2, women: 21.3), while average age at marriage is 27.7 for men and 25.9 for women, an interval of around five years (see Figure A.1). Indeed, university-educated couples are significantly more likely to meet during education or at work (see Figure A.2).

² Assortative mating may have important implications for labor supply (Bredemeier and Juessen, 2013), inequality (Hyslop, 2001; Greenwood et al., 2014; Pestel, 2016) and intergenerational mobility (Ermisch et al., 2006).

is consistent with the observation that women (men) typically tend to “marry up (down)” with respect to the spouse’s socio-economic status. For example, this means that we would expect an increase in the overall female share of students enrolled in a given field to reduce women’s frequency of meeting men with similar levels of education. Consequently, the chances of finding a partner with at least the same (high) earnings potential are more limited, making couple formation in line with social norms more difficult and, hence, less likely.

This paper studies the marriage market effects of the gender composition of university students for individuals of post-secondary education. For this purpose, I use administrative information on the gender composition of students enrolled in (West) German universities broken down by 41 detailed fields of study over the period from 1977 to 2011. The aggregate field-by-year dataset is merged into the 2003–2011 waves of the German Microcensus which contain individual information on the year of graduation as well as the exact field of study for university graduates. This allows me to exploit substantial over-time and within-field variation in student sex ratios experienced at the time of education to estimate the effect on marriage market outcomes such as the marital status and the composition of couples. While previous literature has typically used a segmentation of marriage markets by *levels* of education (in addition to, e.g., age, region, race or ethnicity), this paper is among the first to additionally use detailed information on the field of study for the sub-population of university graduates.³ Since university teaching in Germany is typically very much segmented by fields of study, the field-specific gender composition affects the social environment of students in general and the frequency of meeting potential spouses of the opposite sex in particular to a large extent.

Overall, the analysis shows that the gender composition of fellow students within the field of study during education has significant impacts on marriage market outcomes for university graduates with distinct gender differences in line with gender

³ Bičáková and Jurajda (2015) use labor force survey data from 19 European countries over the period 1998–2010 and test whether the gender composition within eight broadly defined fields of study affect fertility among university graduates. While they do not find an effect on total fertility they present evidence of a higher likelihood of non-endogamous fertility when the gender composition is rather unbalanced. Bičáková and Jurajda (2016) use the same data to describe the strong tendency of matching partners within fields.

identity norms. First, a higher female share of students negatively affects marriage market opportunities for women. Female graduates more often remain single or live in a cohabiting couple and are less often married when women represent a larger share of students in the respective field of study. For men, I find the exact opposite result. A higher share of males in the field is associated with a higher probability of being married, while it is less likely to be single or cohabiting. This means that the pool of potential partners is larger for university-educated men than for women since marrying a partner outside the university environment with a lower level of education and earnings potential (“marrying down”) does not violate social norms. Second, the student sex ratio significantly affects the composition of couples with respect to educational levels and field of study. Unsurprisingly, for both men and women, a higher share of the own gender among fellow students mechanically decreases the probability of having a partner holding a degree in the exact same field. However, I find distinct gender differences for the alternative outcomes of having a partner holding a degree from a different field or having a lower level of formal education. When men are more abundant in the field, male graduates are more likely to “marry down” with respect to educational status, while women are more likely to be in a homogamous relationship when the female share is high. This indicates that the non-university environment is more likely to be the place for partner search for men. Finally, I test whether spouses in educated couples rather tend to marry up or down with respect to the average income or average occupational status of the partner’s field of study when the own-gender share is high. The results indicate that women are negatively affected by an increasing female share within the field since they are more likely to have a partner from a field with lower average income and occupational status which violates social norms.

The remainder of the paper is organized as follows: Section 2 discusses related literature and the theoretical background. Section 3 describes the data. The empirical strategy and the results are presented in section 4. Section 5 concludes.

2 Literature and Background

Literature. Previous studies have shown that imbalanced sex ratios, the number of men relative to women, within a specific population subgroup and a certain age range affects individual marriage prospects and therefore may have important implications for long-run economic and social outcomes. Typically, the relevant population subgroups, i.e., marriage markets, are defined by region, ethnic group, educational level and socio-economic status. Angrist (2002) exploits a major migration episode in the U.S. by using Census data and variation in immigrant flows over time and across ethnic groups in the early 20th century to estimate the effect of sex ratios on the marriage market and labor market outcomes of second-generation immigrants. The results indicate that a higher sex ratio, i.e., an increase in the relative number of men, favors women by increasing their bargaining power. Specifically, marriage rates and household income are higher while labor force participation is lower among women. Using survey data from the U.S. Panel Survey of Income Dynamics, Chiappori et al. (2002) similarly find that an imbalanced sex ratio by age, race and state in favor of women increases female bargaining power indicated by lower levels of labor supply. These results are in line with Negrusa and Oreffice (2010) who exploit U.S. Census data between 1980 and 2000 and find that more favorable sex ratios by metropolitan area and educational attainment for women reduces wives' labor supply but increases that of husbands. Abramitzky et al. (2011) study the marriage market prospects of young men in France before and after World War I exploiting exogenous variation in male scarcity across regions in France due to war-related fatalities. They find that in regions where men were scarcer they improved their position in the marriage market, specifically by marrying up the social ladder. Similarly, Edlund (1999) shows that in societies where sons are preferred over daughters, prenatal sex determination causes stratification by gender with women selectively more likely to be born into lower-class families with the prospect of marrying up. This harms marriage market prospects of lower-class men. Effects of variation in sex ratios may additionally have longer-term impacts. Bitler and Schmidt (2012) show that a higher share of young men drafted for the Vietnam War in the U.S. negatively affected marriage and fertility rates among young women.

Educational System as a Marriage Market. The literature has documented that variation in the sex ratio has strong implications for marriage market outcomes in very different settings. The socio-economic status in general and the level of educational attainment in particular play an important role for determining marriage market opportunities, especially in modern societies. However, little is known about the exact mechanisms how gender imbalances by educational attainment translate into marriage market opportunities. This paper explicitly addresses the role of the university education as a marriage market for high-skilled individuals and examines the effects of gender imbalances among university students by detailed fields of study on marriage market outcomes of university graduates. The system of tertiary education may represent an important marriage market for this group for several reasons. First, peer group composition among university students is very homogeneous regarding age and (expected) educational attainment. Any educational system implies a stepwise positive selection into higher education by imposing entry barriers typically requiring some minimum formal qualification. This mechanically creates increasingly homogeneous groups with increasing age (Blossfeld and Timm, 2003) and the literature has documented that individuals typically prefer similar spouses, particularly regarding age and education (Mare, 1991; Kalmijn, 1991). Using data from Chile, Kaufmann et al. (2013) find that being admitted to a higher-ranked university program has a considerable effect on partner quality for women and also to a lesser extent for men. This works partly through the university as a meeting place but also through social networks of colleagues in the workplace and friends. Second, marriage typically takes place after the completion of education. This implies that the years of study at university largely overlap with periods of partner search. Hence, the educational peer group features preferential spousal characteristics and may represent a primary search pool for potential spouses. However, the observed frequency of successful couple matches within the educational peer group will also depend on the extent of search frictions. While most of the literature implicitly assumes that marriage markets are large and frictionless, search costs are higher when the gender composition is very unbalanced or when there is a low degree of interaction within the peer group. In a related paper, Mansour and McKinnish (2014) study whether disproportionate rates of within-occupation matching of couples in

the U.S. are rather due to preferences for a spouse with the same occupation or due to lower search costs within the workplace environment. Exploiting variation in the occupational gender composition, they test opposing theoretical predictions following from the two alternatives and find that their empirical results are more in line with a search cost explanation.

3 Data and Descriptives

Data Sources. The analysis is based on microdata from the German Microcensus (2011), which is an annual cross-sectional survey of private households in Germany covering one per cent of the population. Participation is required by law for sampled households. In addition to core socio-demographic variables on the individual level, the Microcensus waves contain detailed information on the field of study and the year of graduation for individuals holding a university degree since 2003. The Microcensus data is combined with administrative information on the total number and gender composition of students enrolled in (West) German universities by 41 fields of study from annual publications of the German Statistical Yearbook over the period 1977–2011 (Destatis, 1992, 2012).⁴

Sample. The estimation sample comprises men and women aged 30–45 (birth cohorts 1958–1981) holding a university degree and have non-missing information on the year of graduation and field of study. Individuals from East Germany are excluded since the information from the Statistical Yearbooks is limited to West Germany until 1992 and only comprises students at East German universities thereafter. In addition, individuals with a non-German nationality are dropped since the data do not allow to disentangle whether foreigners have received their degree at a university in Germany or in the home country. Individuals who graduated from university after age 34 are dropped, since their period of education may arguably not overlap as much with the age of partner search. Finally, I use only individual

⁴ Being administered by the German Statistical Office, both the Microcensus data and the Statistical Yearbook information employ a harmonized classification of fields of study. Each data year in the Statistical Yearbooks refers to the latter calendar year of winter terms (typically from October to March). Harmonized data are available since 1977.

observations who either live in a single or couple household (both married and cohabiting) and are not widowed nor divorced. Overall, the sample comprises 45,349 men and 33,140 women. Summary statistics are presented in Table 1.

Marriage Market Outcomes. The left panel of Figure 1 shows the share of all couple households where at least one of the spouses holds a tertiary degree, which went up from 25% in 2003 to 34% in 2011. This was largely due to an increasing share of couples where both spouses hold a university degree from 9% to 15%. Among them the share of same-field couples almost quadrupled from 1.1% to 4.4%. The right panel shows that the increasing educational sorting in couple composition was even more pronounced among households in the top income decile. The share of couples with at least one university graduate increased from 60% in 2003 to 74% in 2011 while the sub-group of dual-educated couples increased from 30% to 45% (same-field couples from 4% to 15%). This underlines the importance of couple formation among the high-educated population for assortative mating and income inequality.

Figure 2 shows that, on average, the composition of couples with university-educated spouses is very different between men and women. While the marital status does not differ between male and female graduates – about 30% are single and roughly 60% are married – the level of education does. Among the 71% of men living in a couple household more than half (36%) are in a relationship with a women of lower education, i.e., without a university degree. For women, this number is 21% out of 69% corresponding to less than one third. This reflects the pattern of men being more likely to “marry down” with respect to education than women. Among both male and female graduates whose partner also holds a university degree about one third holds a degree in the exact same field (12% of men and 16% of women) and the remaining two thirds (23% and 32%) are from a different field.

Gender Composition of Students. The purpose of this paper is to study whether over-time changes in the gender composition of students within fields of study drive the observed differences in marriage market outcomes for university graduates. Based on the Statistical Yearbook information, Figure 3 shows the total

number of university students enrolled in (West) Germany as well as the gender composition, indicated by the share of females between 1977 and 2011. Over this period, the total number of students in Germany more than doubled from about 850,000 to 1.9 million and the gender composition has changed considerably. In 1977, about one third of students were women and the female share has continuously increased to 48% in 2011.⁵

While an increasing share of female university students is observed for virtually all fields of study, the overall change in the gender composition was not uniformly distributed across fields. Figure 4 shows the 1977–2011 changes in the share of female students by field of study.⁶ The substantial variation indicates that the social environment during university education in terms of the gender composition among fellow students has changed considerably for older cohorts compared to younger cohorts of university graduates. A number of fields have actually switched from being predominantly male to predominantly female. For example, this is true for Architecture, Law and virtually all fields in Medical Sciences. Despite considerable increases in the share of women enrolled, fields in Engineering are still predominantly male, while fields in Humanities have become even more female. Other fields, that had a low female share are nowadays rather balanced in terms of the gender composition, e.g., Economics/Business or Agriculture.

The distinct gender patterns of selection into fields of study is reflected in the sample of university graduates from the Microcensus data. Figure 5 shows that while about one third of both male and female students have graduated in a field within Social Sciences, men are more likely to have a degree in Engineering (35%) or Natural Sciences (16%) than women (both 10%). At the same time, 33% of women have graduated in a field within Human Sciences with the number for men standing at 10%. These differences in choice of field is reflected in the share of the

⁵ The observed growth in both the total number as well as the female share of university students is due to several factors. First, the system of tertiary education in Germany expanded rapidly during the 1970s responding to the demand from large birth cohorts in the 1950s and 1960s. The state invested in additional capacities by expanding existing universities and by founding new ones. Second, the women's movement in the 1960s promoted an increase in female participation in university education. This was, third, accompanied by the introduction of a financial support scheme targeted at students from low-income backgrounds, which turned out to be particularly beneficial for women.

⁶ Figures A.14–A.24 in the Appendix show the year by year changes for each field of study.

own gender among fellow students at the time of university education. On average, men experience a 67% male share among students within the field of study and women experience a female share of 52%. However, as discussed previously, there is substantial variation in the gender composition across fields but also within fields over time, which is exploited in the regression analysis.⁷

4 Estimation of Marriage Market Effects

4.1 Empirical Strategy

The empirical strategy exploits variation in the gender composition of university students over time and by field of study to estimate the impact on marriage market outcomes of university graduates. The empirical model reads:

$$y_{igft} = \alpha + \beta \times share_{gf} + X'_{igft}\gamma + \delta_f + \delta_t + \delta_{c(i)} + \delta_{s(it)} + \varepsilon_{igft}, \quad (1)$$

where y_{igft} denotes the respective outcome of an individual i who graduated in year g in field of study f and was interviewed in wave t . The outcomes are binary indicators of the marital status for the entire sample and, for the subsample of individuals living in a couple household, the composition of the couple regarding the spouse's level of education and field of study. The main variable of interest is $share_{gf}$ corresponding to the *own-gender share* of students that prevailed in graduation year g experienced by individuals during university education in field f . The set of controls X_{igft} include a binary indicator for living in an urban area and the log total number of students enrolled in field f in year g . In addition, I include a number of fixed effects δ for field of study f and wave t as well as for individuals' birth cohorts c and state of residence s in wave t . Equation (1) is estimated separately for men and women using a linear probability model with standard errors clustered on the field by graduation year level.

Using the gender composition within fields of study may raise concerns about

⁷ Table A.1 shows the mean female share experienced for all 41 fields. Figure A.3 shows the distribution of the field-specific female share of students by six field groups for both men and women.

endogenous self-selection into particular fields that is mainly driven by marriage market rather than labor market considerations. For example, one could imagine that individuals who prefer to have a university graduate as a spouse may self-select into fields where the own-gender share of students is low. In that case, the resulting gender composition would to some extent result from preferences for specific marriage market outcomes and, hence, reverse causality would be an issue. However, individuals predominantly choosing fields of study where their own gender is scarce would imply that in the longer run the gender composition by field of study should become more balanced. This is true for some fields, but is at odds with the observation that the female share increased in virtually all fields, i.e., also in those that had already been predominantly female. In addition, a number of fields are still predominantly male. Nevertheless, field fixed effects δ_f control for unobserved time-invariant field of study characteristics that are related to the frequency of meeting opposite-sex individuals. Importantly, this takes into account the fact that some fields have been traditionally male- or female-dominated (e.g., fields in Engineering vs. fields in Humanities) and, hence, I only exploit variation in the gender composition *within* fields over time. In addition, in a robustness check I restrict the estimation sample to university graduates from fields where endogenous self-selection with regard to marriage market considerations is arguably very limited due to admission restriction rules.

4.2 Estimation Results

Effects on Marital Status. The analysis of marriage market effects of the gender composition among university students begins by examining the impact of the own-gender share on outcomes related to marital status, i.e., whether a university-educated individual is single, is cohabiting or married at the time of the survey. The estimation results are displayed in Table 2.

The baseline effects in Panel A show that a higher own-gender share of students significantly improves marriage market prospects of men, but impair those of women. The estimates displayed in columns (1) and (2) indicate that being single or cohabiting is significantly less likely among men when the male share in the field of

study during university education was high. At the same time, the result in column (3) shows that being married is significantly more likely. An increase in the male share of students by one percentage point on average increases the marriage rate by 1.3 percentage points among university-educated men. For women, the corresponding results for marital status are exactly of opposite sign. The estimates in columns (4) and (5) show that a larger female share among fellow students increases the likelihood of remaining single or cohabiting, while the prospects of being in a married couple is strongly reduced. The estimate in column (6) implies that a one percentage point increase in the female share within the field of study reduces the likelihood of being married by about two percentage points. Panel B of Table 2 shows estimation results for marital status outcomes interacted by six larger field groups in order to see whether there are heterogeneities in the effect of the gender composition of students within the field across different types of fields. For both men and women and for all outcomes, the results are qualitatively the same across all field groups. Quantitatively, the effects of the own-gender share appear to be somewhat more pronounced for graduates from fields in Engineering and Arts.

Overall, the results for marital status outcomes imply that for university-educated women a relative scarcity of male students within the field of study hampers couple formation, in particular regarding entering marriage. At the same time, a high male share does not impair men’s marriage market prospects. Note that the secular trend for virtually all fields of study described in the previous section is characterized by an increasing female (decreasing male) share of students. This means that the observed changes in the gender composition of university students actually impairs the likelihood of entering marriage for both male and female graduates.

Effects on Couple Composition. The results discussed in the previous section have shown that the own-gender share among university students within the field of study affects couple formation. We now turn to outcomes related to the composition of couples conditional on living in a couple household with respect to the level of education, i.e., whether an individual’s partner has attained university education as well, and whether university-educated partners are from the same field. The results are displayed in Table 3. Columns (1) and (4) of Panel A show the baseline results

for living with a partner who obtained a university degree in the exact same field of study. As expected, for both men and women a higher own-gender share reduces the likelihood of being in a same-field couple. However, this effect is statistically insignificant for men and, though somewhat larger in magnitude, only marginally significant for women. Note that field fixed effects already capture to a large extent patterns of within-field mating, e.g., by being traditionally dominated by one gender reducing search costs for the opposite outnumbered gender (Mansour and McKinnish, 2014).⁸ The estimates in column (1) of Panel B show that the effect is only significant for male students in medical fields.

When the own-gender share within the field of study is high making within-field mating less likely, the alternative outcomes for couple composition are being with a same-education partner from a different field or a partner with a lower than tertiary level of education. For these outcomes, I find distinct gender differences. Columns (2) and (3) of Panel A show that male graduates are much less likely to be with a woman from a different university field and more likely to “marry down” with respect to the level of education, which is perfectly in line with gender identity norms. The respective columns in Panel B indicate that the resulting pattern is mainly driven by fields in Engineering and Medical Sciences. For women, the effects of the own-gender share on couple composition is again of the opposite sign. Columns (5) and (6) of Panel A show that the main alternative to a same-field partner is clearly a university-educated man from another field. The interactions with field groups in Panel B indicate that the results for women are most pronounced in fields within Humanities, Medical Sciences or Engineering.

Taken together, these findings are consistent with gender preferences for marrying up or down the educational ladder. Since women usually prefer to marry up, the most important alternative pool for partner search to the own field seems to be the wider university environment of different fields of study. At the same time, men are more likely to search for partners outside the university environment, implying

⁸ Other reasons may be occupational complementarities. For example, those fields with a very high share of same-field couples are, among others, Human Medicine, Pharmaceuticals, Pedagogics or Protestant Theology. These fields have in common that they more easily allow for dual careers. Think of medical practitioner couples jointly running a practice.

heterogamous marriage with respect to education.⁹

Effects on Marrying Up. While the level of education, in particular having graduated from university, is considered as an extremely important aspect of socioeconomic status, there are further characteristics, such as income and occupational prestige, that affect an individual's status in society. In order to test whether the field-specific gender composition of fellow students also affects couples' composition in terms of status, I compute for each field of study the average income as well as the average occupational prestige score (ISEI) among graduates within my estimation sample.¹⁰

The idea is to proxy expected values for income and prestige of a particular field of study since occupations are not necessarily tied to specific fields, but some fields may be more represented in some occupations than others. For example, according to the ISEI index doctors and lawyers are assigned the maximum value of 85, which means that graduates from fields in Medical Sciences or Law can be expected to work in high-prestige occupations. For the sub-sample of university-educated individuals who are in a couple with a different-field graduate, I use this information to test whether they “marry up” either with respect to income or occupational status. Marrying up is a binary indicator meaning that the partner is from a field with a higher average income or status than the own field of study. The results are displayed in Table 4. Columns (1) and (3) of Panel A show that men are more and women are less likely to marry a spouse from a field with higher average income when the own-gender share increases. This means that an unfavorable gender composition implies that couple formation in line with social norms becomes more difficult for both men and women. The results for marrying up with respect to occupational prestige (columns 2 and 4) are statistically insignificant, which might be due to the

⁹ Another mechanism behind these results could be the fact that the overall female share of students has always been below 50% for the entire sample though increasing over time (see Figure 3). Hence, female students may be overrepresented in some fields, but are always outnumbered on aggregate, making the wider university environment more attractive for partner search.

¹⁰ The average income by field is the mean of individual monthly net income among full-time workers (35 hours per week and more) among the estimation sample (see black diamonds in Figure A.10). The occupational prestige score is the mean value of the International Socio-Economic Index of Occupational Status (ISEI, see Ganzeboom et al., 1992) among graduates from the respective field varying between a minimum of 16 and a maximum of 85 (see Figure A.11).

fact that the prestige score levels do not vary very much across fields of study. Most occupations university graduates work in are of relatively high prestige.

4.3 Robustness Checks.

Non-linear relationship. The regression results presented in Tables 2–4 are based on a linear specification of equation (1). However, non-linear relationships between the gender composition in the field of study and the marriage market and couple composition results may be plausible as well. For example, the linear estimates may be driven by individuals who experienced extremely unbalanced gender compositions. For this purpose, I run specifications where the continuous own-gender share is replaced by a series of indicators for specific levels of the gender share. The results for marital status outcomes are shown in Figure A.4 and reveal a fairly linear pattern. The only exception appears to be the negative effect for men on living in an unmarried couple to be mainly driven by male share beyond 50%. Figure A.5 shows the respective results for couple composition. Here, it turns out that the results for men are mainly driven by male graduates who experienced a male share of students between 25% and 75%. For women, the positive effect on being with a male graduate from a different field reveals a rather linear pattern across the entire distribution of the student gender composition. At the same time, the effect on having a same-field partner is mainly driven by women having experienced a female share of students below 50%, while the negative effect on having a spouse of lower education mainly comes from female shares above 50%.

Timing of relevant gender composition. In the baseline specification, the gender composition assigned to each individual is based on the exact field of study and the year of graduation in that field. However, a university graduate’s field-specific gender composition reflecting marital search conditions may not be the one that prevailed in the year of graduation, i.e., at the end of education, but rather the one at the beginning of or during the course of study. Unfortunately, the year of starting university education is not available in the Microcensus data. That is why I present regression results assigning the gender composition of students between one

and ten years before the year of graduation.¹¹ The results are presented in Figures A.6 and A.7 and are very similar to the baseline specifications (equal to zero years before graduation). This is however not surprising given the fact that, while the gender composition has changed substantially in some fields of study over several decades the year by year levels are highly correlated.

Admission restrictions. In order to address potential concerns regarding selection into fields of study being mainly driven by marriage market rather than labor market considerations, I present estimation results exploiting field-specific information on admission restriction rules. Admission to university education in specific fields can either be restricted at the central (federal) level or at the local (university) level. Central restriction of admission implies that only applicants whose overall score in their secondary school leaving examination (*Abitur*) passes a minimum threshold, which differs across fields and over time.¹² The main purpose is to allocate applicants for a place at university in fields where demand exceeds available capacities which mainly applies to fields in Medical Sciences. In addition, individual universities may also define their own admission restriction rules for specific fields. For this purpose, I compile administrative information on annual field-specific admission restrictions from the German Rector’s Conference (*Hochschulrektorenkonferenz*), an umbrella organization of German universities. The dataset is based on annual publications listing the situation of admission restriction (free admission, local restriction or central restriction) for each field at each university in Germany. This allows me to compute an index of admission restriction ranging from zero (free admission) and 100% (admission fully restricted). Values in between give the percentage of German universities where admission to the respective field is restricted in a given year. Over the period under consideration between 1977 and 2011, the extent of admission restriction varies substantially both across fields and within fields over time, see Figures A.12 and A.13. Enrolling in university education in a field where

¹¹ For example, in the baseline specification an individual who graduated in 2000 is assigned the respective field-specific gender share in that year. In the alternative specifications the individual is assigned the gender share that prevailed in 1999, 1998, and so on.

¹² In addition, waiting time as well certain quotas for disadvantaged groups are also used as auxiliary criteria.

admission is restricted may not fully rule out the possibility that the motivation for choosing the respective field is driven by marriage market considerations. However, I argue that this is much less likely since enrolling in a restricted field is costly from an individual's point of view. First, some applicants may have to wait one or more semesters before they are actually admitted. Second, particularly the central level restriction typically implies that the choice of specific university is beyond the control of the individual applicant. Both aspects substantially increase the opportunity costs of choosing a restricted field of study, making it much more likely that the motivation is primarily (if not only) driven by labor market considerations. For this reason, I run regressions where the sample is restricted to individuals who graduated from a field of study where admission was restricted to large extent, indicated by the percentage of admission-restricted universities, five years prior to graduation. The results are shown in Figures A.8 and A.9 and indicate that the effects of gender composition in restricted fields are very much in line with the baseline results.

5 Conclusions

This paper studies how the gender composition among students by field of study affects marriage market outcomes of university graduates in Germany. Using rich data from the German Microcensus combined with aggregate information for more than 40 fields of study over the period 1977–2011, I exploit over-time variation in the gender composition within fields of study.

The main findings of the paper show that the gender composition of fellow students within the field of study experienced during education has significant impacts on marriage market outcomes for university graduates with distinct gender differences. First, a higher own-gender share of students negatively affects marriage market opportunities for women by increasing the likelihood of remaining single and reducing marriage rates, while the opposite is true for men. Second, an imbalanced student sex ratio significantly affects the composition of couples in terms of education and the field of study. A higher share of the own gender decreases the probability of having an opposite-sex partner from the exact same field. At the same

time, men are more likely to marry down with respect to educational status, while women rather have a partner with the same level of education.

Overall, the results of this study are in line with gender identity norms with respect to couple formation, implying that women typically prefer to “marry up” the socio-economic ladder (Bertrand et al., 2015). These findings imply that changes in the gender composition of students may have implications for the socio-demographic composition of societies since we may expect increases in assortative mating of couples when the formation of same-field relationships is enhanced in male-dominated fields. This may have longer-run impacts on income inequality and intergenerational mobility. At the same time, further increases in the female share of students in fields already dominated by women may increase the number of university-educated women remaining single (longer), which may in turn have negative implications for fertility among high-skilled women.

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Figures and Tables

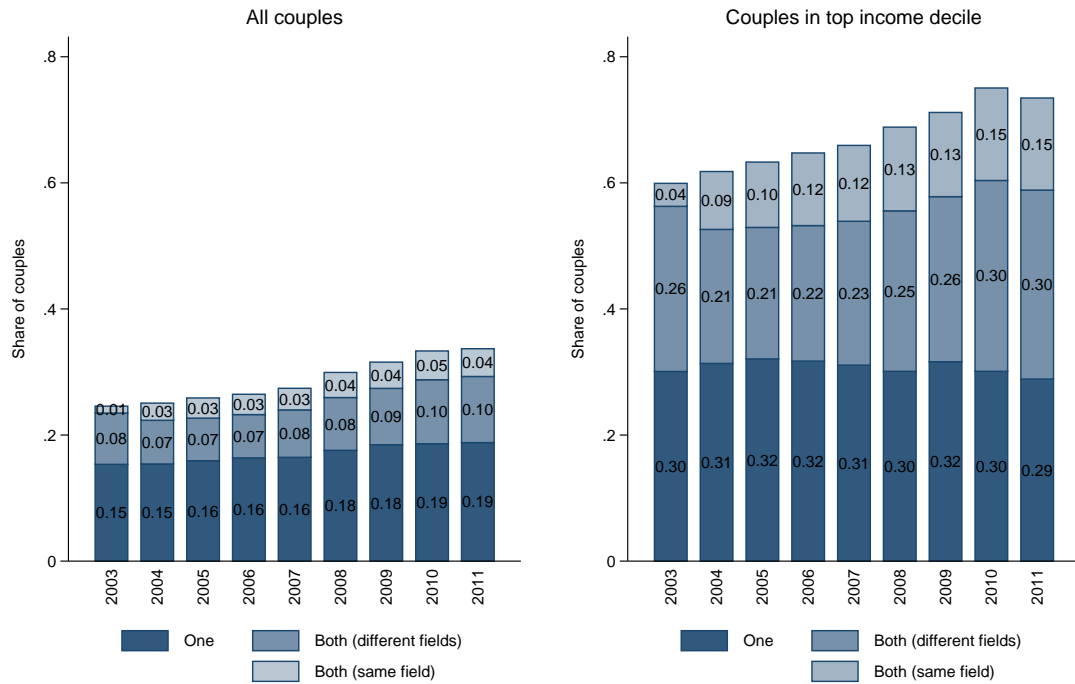


Figure 1: Number of university-educated spouses in couple households

Note: This bar chart shows the composition of couples with respect to spouses' level and field of education, i.e., whether only one or both partners are university-educated. The share of dual-educated couples is split based on whether both partners hold a degree in the exact same or in a different field. The left panel refers to all couples, while the right panel focuses on couples in the top income decile. *Source:* Microcensus 2003–2011, own calculations.

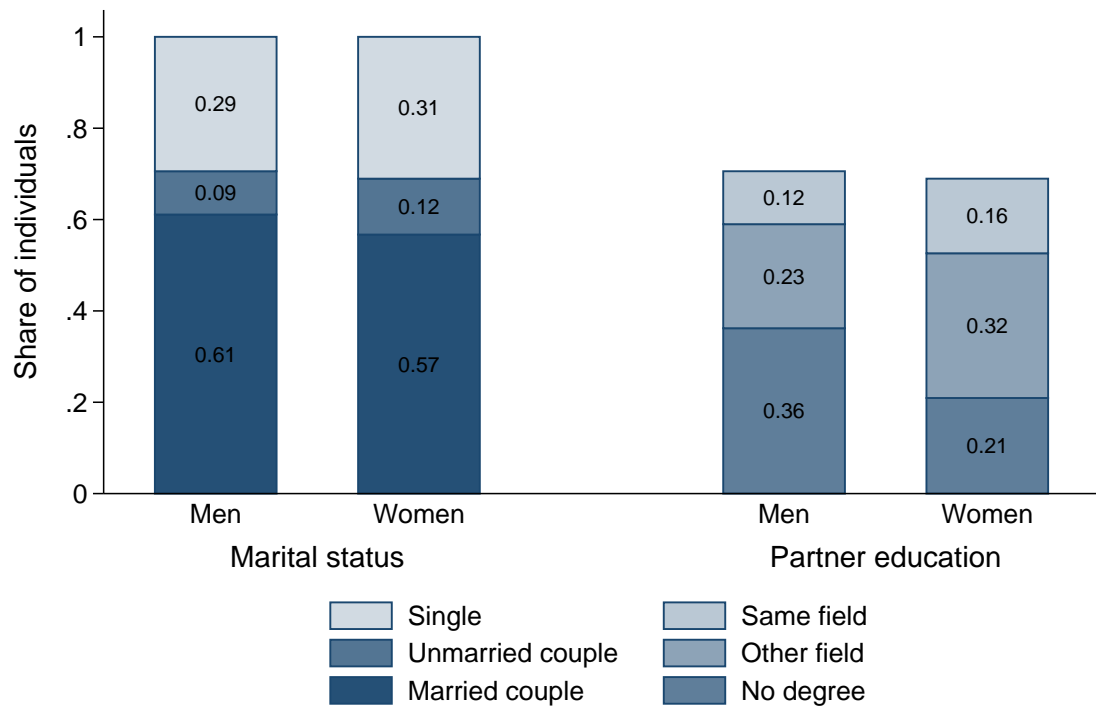


Figure 2: Marital status and couple composition

Note: This bar chart shows the marital status (left panel) as well as the composition of couples with respect to the partners level and field of education (right panel) of university-educated individuals aged 30–45. *Source:* Microcensus 2003–2011, own calculations.

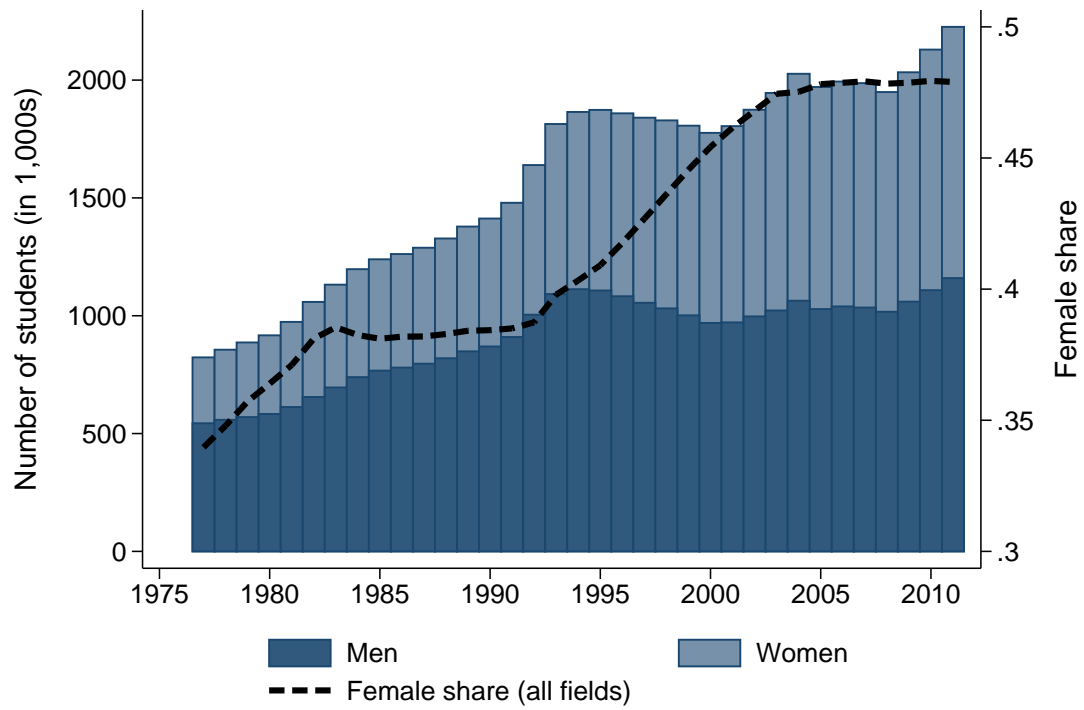


Figure 3: University students in Germany

Note: This bar chart shows the total number of university students in Germany by gender and over time (left axis) as well as the corresponding share of female students (right axis). *Source:* Statistical Yearbooks, own calculations.

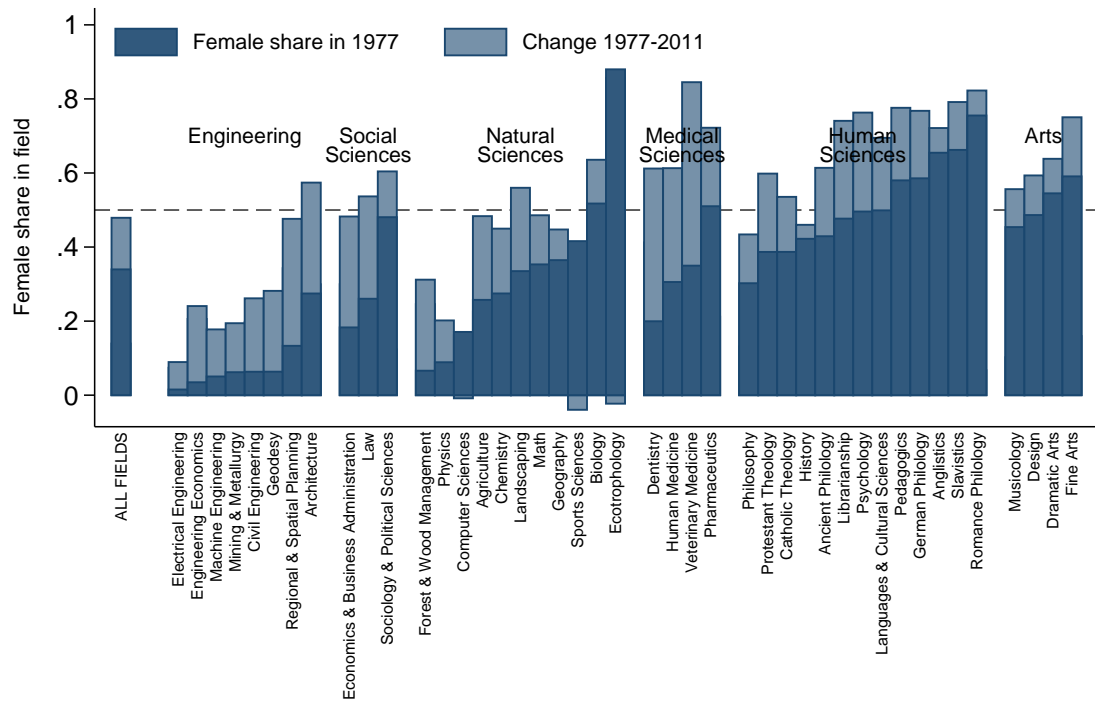


Figure 4: Gender composition of university students by field of study

Note: This bar chart shows the female share of students by field of study in 1977 and its change between 1977 and 2011. The horizontal line indicates a female share of 50%, where the gender composition is perfectly balanced.
Source: Statistical Yearbooks, own calculations.

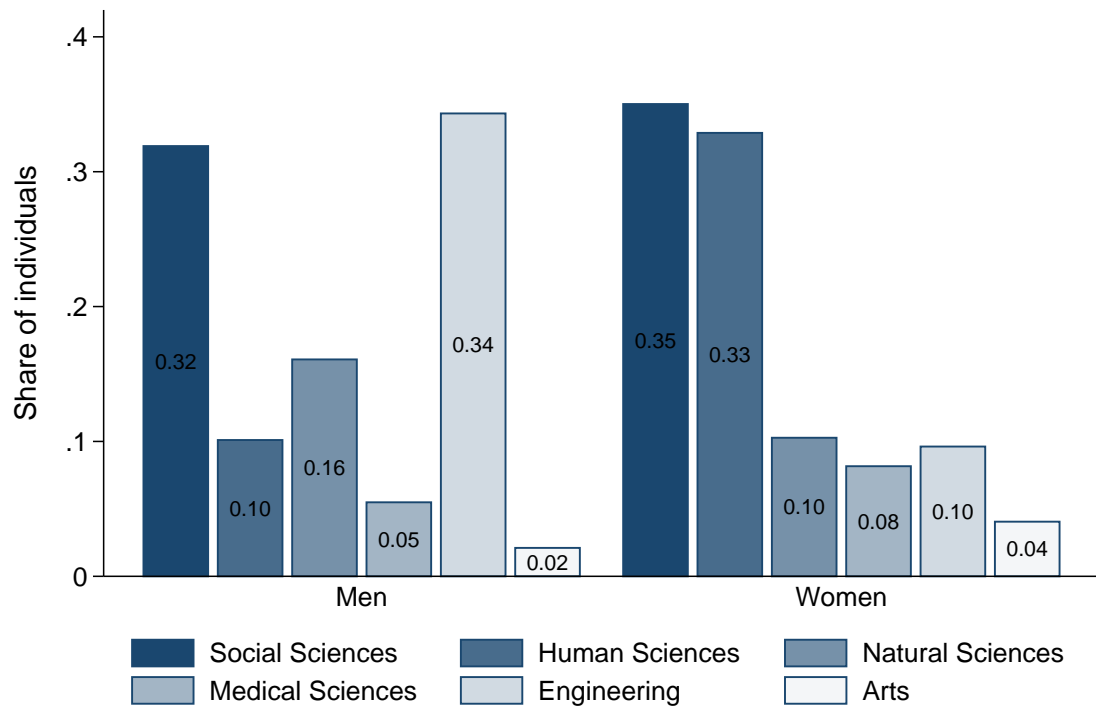


Figure 5: Composition by field group

Note: This bar chart shows the composition of the university-educated population aged 30–45 with respect to the field of study they graduated in broken down by six larger field groups. See Table A.1 for a complete list of fields and the assignment to field groups. *Source:* Microcensus 2003–2011, own calculations.

Table 1: Summary statistics

	Men (N=45349)				Women (N=33140)			
	Mean	Sd	Min	Max	Mean	Sd	Min	Max
Marital status								
Single	.29	.46	0	1	.31	.46	0	1
With partner	.71	.46	0	1	.69	.46	0	1
Married	.61	.49	0	1	.57	.5	0	1
Unmarried	.09	.29	0	1	.12	.33	0	1
Partner characteristics								
Partner no univ. degree	.36	.48	0	1	.21	.41	0	1
Partner with univ. degree	.34	.47	0	1	.48	.5	0	1
Partner in same field	.12	.32	0	1	.16	.37	0	1
Partner in other field	.23	.42	0	1	.32	.47	0	1
Field of study								
Field in Social Sciences	.32	.47	0	1	.35	.48	0	1
Field in Human Sciences	.1	.3	0	1	.33	.47	0	1
Field in Natural Sciences	.16	.37	0	1	.1	.3	0	1
Field in Medical Sciences	.05	.23	0	1	.08	.27	0	1
Field in Engineering	.34	.47	0	1	.1	.29	0	1
Field in Arts	.02	.14	0	1	.04	.2	0	1
Gender share in field	.67	.21	.11	.99	.52	.18	.02	.89
Log of students in field	11.28	.99	7.15	12.74	11.22	.94	7.26	12.74
Other Controls								
Year of birth	1968.97	4.84	1958	1981	1970.68	4.96	1958	1981
Urban area	.25	.44	0	1	.3	.46	0	1

Note: This table shows summary statistics on marital status and field of study for a sample of university-educated individuals aged 30–45 in Germany. The *gender share* in the field of study refers to the year of an individual's graduation. *Urban area* indicates whether the individual lives in a city with more than 500,000 inhabitants. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

Table 2: Effect of gender share on marital status

Sample	(1)	(2)	(3)	(4)	(5)	(6)
	All men			All women		
Outcome	Single person	Unmarried couple	Married couple	Single person	Unmarried couple	Married couple
A. Baseline Effect						
Gender share	-0.891*** (0.113)	-0.401*** (0.068)	1.293*** (0.121)	1.425*** (0.140)	0.554*** (0.098)	-1.979*** (0.152)
Log number of students	0.040*** (0.013)	0.002 (0.009)	-0.042*** (0.015)	0.095*** (0.021)	0.016 (0.014)	-0.111*** (0.022)
Urban area	0.150*** (0.007)	0.041*** (0.004)	-0.191*** (0.007)	0.168*** (0.008)	0.037*** (0.005)	-0.205*** (0.008)
Observations	45349	45349	45349	33140	33140	33140
Adjusted R^2	0.111	0.024	0.154	0.060	0.035	0.101
B. Effect by Field Group						
Gender share \times Social Sciences	-0.770*** (0.136)	-0.434*** (0.091)	1.203*** (0.145)	1.535*** (0.181)	0.540*** (0.127)	-2.075*** (0.190)
\times Human Sciences	-1.096*** (0.311)	-0.257 (0.156)	1.353*** (0.296)	1.542*** (0.251)	0.707*** (0.191)	-2.249*** (0.297)
\times Natural Sciences	-0.823*** (0.217)	-0.483*** (0.145)	1.306*** (0.219)	1.469*** (0.283)	0.387** (0.191)	-1.856*** (0.313)
\times Medical Sciences	-0.799*** (0.173)	-0.240** (0.096)	1.039*** (0.180)	1.127*** (0.187)	0.526*** (0.144)	-1.654*** (0.200)
\times Engineering	-1.351*** (0.186)	-0.557*** (0.107)	1.908*** (0.199)	1.997*** (0.323)	0.828*** (0.194)	-2.825*** (0.375)
\times Arts	-1.729** (0.800)	-0.036 (0.538)	1.764** (0.889)	3.548*** (0.784)	0.599 (0.482)	-4.147*** (0.674)
Observations	45349	45349	45349	33140	33140	33140
Adjusted R^2	0.112	0.024	0.155	0.061	0.035	0.102
Field FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are clustered on the level of field by graduation year. *** = significant at the 1 percent level, ** = significant at the 5 percent level, * = significant at the 1 percent level.

Table 3: Effect of gender share on partner's education and field

Sample	(1)	(2)	(3)	(4)	(5)	(6)
	Men in couples			Women in couples		
	Degree		No degree	Degree		No degree
Outcome	same field	other field		same field	other field	
A. Baseline Effect						
Gender share	-0.128 (0.123)	-0.423*** (0.141)	0.551*** (0.159)	-0.336* (0.178)	0.784*** (0.183)	-0.447** (0.198)
Log number of students	0.028** (0.012)	0.014 (0.020)	-0.042* (0.021)	0.124*** (0.022)	0.028 (0.028)	-0.152*** (0.030)
Urban area	0.047*** (0.007)	0.115*** (0.009)	-0.162*** (0.009)	0.037*** (0.010)	0.063*** (0.010)	-0.100*** (0.009)
Observations	32005	32005	32005	22849	22849	22849
Adjusted R^2	0.106	0.051	0.076	0.061	0.040	0.040
B. Effect by Field Group						
Gender share \times Social Sciences	0.014 (0.185)	-0.223 (0.167)	0.209 (0.205)	-0.355 (0.233)	0.472** (0.229)	-0.118 (0.255)
\times Human Sciences	-0.562 (0.370)	-0.074 (0.276)	0.636 (0.410)	-0.110 (0.263)	0.846*** (0.279)	-0.737** (0.317)
\times Natural Sciences	-0.069 (0.232)	-0.391 (0.282)	0.460 (0.302)	-0.178 (0.297)	0.778** (0.341)	-0.600* (0.313)
\times Medical Sciences	-0.437** (0.186)	-0.334 (0.218)	0.771*** (0.207)	-0.507 (0.310)	0.922*** (0.259)	-0.414 (0.275)
\times Engineering	0.076 (0.141)	-1.036*** (0.226)	0.960*** (0.240)	0.043 (0.377)	1.839*** (0.461)	-1.881*** (0.437)
\times Arts	1.067 (0.984)	-3.801*** (1.104)	2.734** (1.310)	0.937 (0.760)	0.428 (1.084)	-1.365 (0.911)
Observations	32005	32005	32005	22849	22849	22849
Adjusted R^2	0.106	0.052	0.076	0.061	0.040	0.041
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Field FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are clustered on the level of field by graduation year. *** = significant at the 1 percent level, ** = significant at the 5 percent level, * = significant at the 1 percent level.

Table 4: Effect of gender share on marrying up

Sample	(1)	(2)	(3)	(4)
	Men in educated couples		Women in educated couples	
Outcome	Marry up (income)	Marry up (status)	Marry up (income)	Marry up (status)
A. Baseline Effect				
Gender share	0.428** (0.196)	0.022 (0.184)	-0.338* (0.179)	-0.276 (0.198)
Log number of students	0.029 (0.029)	0.001 (0.028)	-0.061** (0.030)	0.021 (0.036)
Urban area	0.008 (0.013)	-0.012 (0.012)	-0.021** (0.010)	-0.033*** (0.011)
Observations	9796	9796	9752	9752
Adjusted R^2	0.216	0.361	0.500	0.394
B. Effect by Field Group				
Gender share \times Social Sciences	0.271 (0.288)	0.354 (0.262)	-0.093 (0.268)	-0.307 (0.267)
\times Human Sciences	1.283** (0.604)	0.293 (0.680)	0.027 (0.356)	-1.026** (0.442)
\times Natural Sciences	0.597 (0.368)	-0.414 (0.377)	-1.311*** (0.467)	0.279 (0.419)
\times Medical Sciences	0.239 (0.169)	0.020 (0.226)	-0.416** (0.166)	-0.031 (0.226)
\times Engineering	0.653* (0.352)	-0.132 (0.328)	-0.169 (0.411)	-0.843* (0.485)
\times Arts	0.557 (1.102)	-0.709 (1.859)	-0.998* (0.559)	1.809** (0.850)
Observations	9796	9796	9752	9752
Adjusted R^2	0.216	0.361	0.501	0.394
Field FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes

Note: Standard errors are clustered on the level of field by graduation year. *** = significant at the 1 percent level, ** = significant at the 5 percent level, * = significant at the 1 percent level.

A Appendix



Figure A.1: Age at completing education and marriage

Note: This graph shows the distribution of individuals' age at completing education and age at marriage by gender and level of education. *Source:* Microcensus 2003–2011, own calculations.

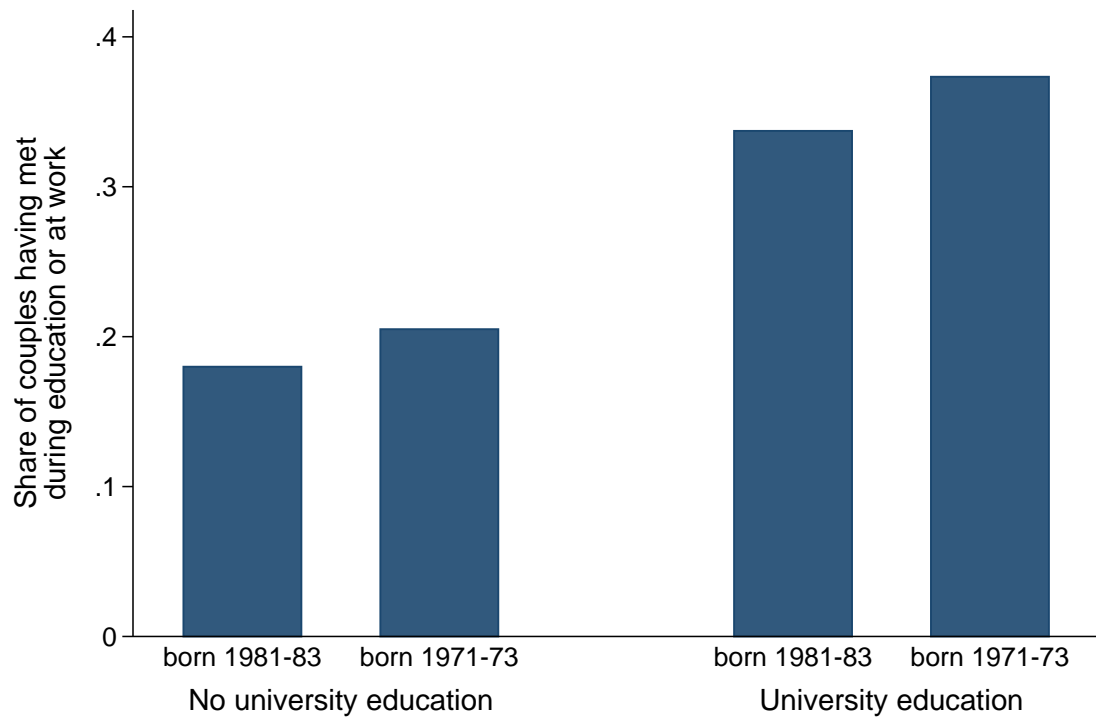


Figure A.2: Meeting of partner during education or at work

Note: This graph shows the fraction of couples who state that they have met in school, during education or at the workplace by level of education and birth cohort. *Source:* Panel Analysis of Intimate Relationships and Family Dynamics (pairfam), wave 1 (2008/2009), own calculations.

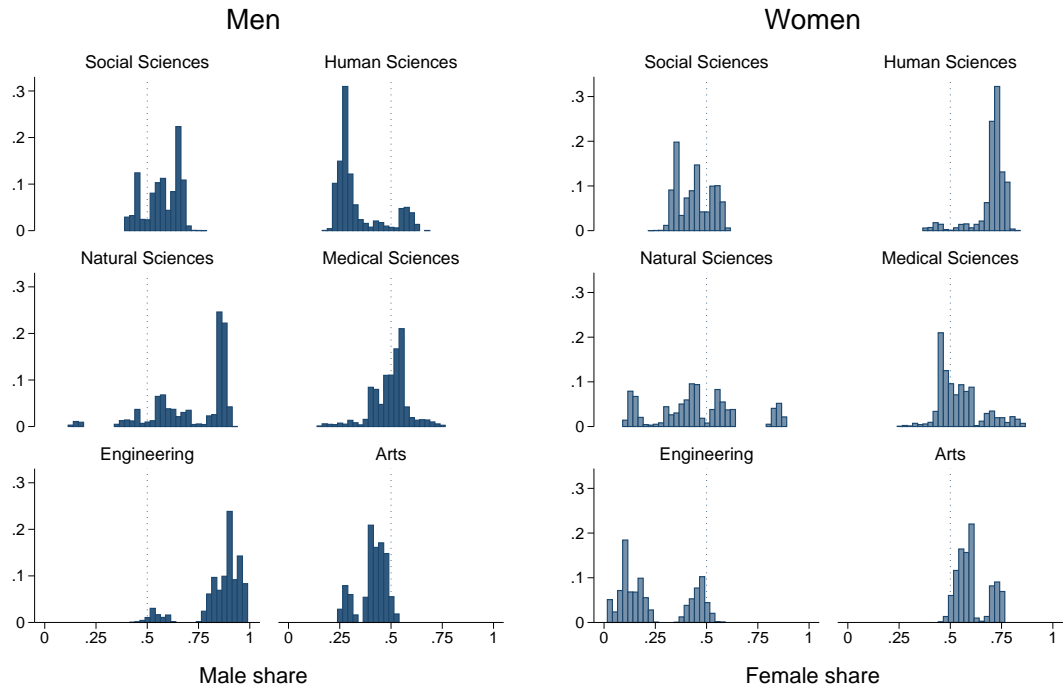


Figure A.3: Distribution of female share within field of study by field group

Note: This histogram graph shows the distribution of the gender share among students within field of study during university education by field groups. The vertical dashed lines indicate a perfectly balanced gender composition with a female share of 50%. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

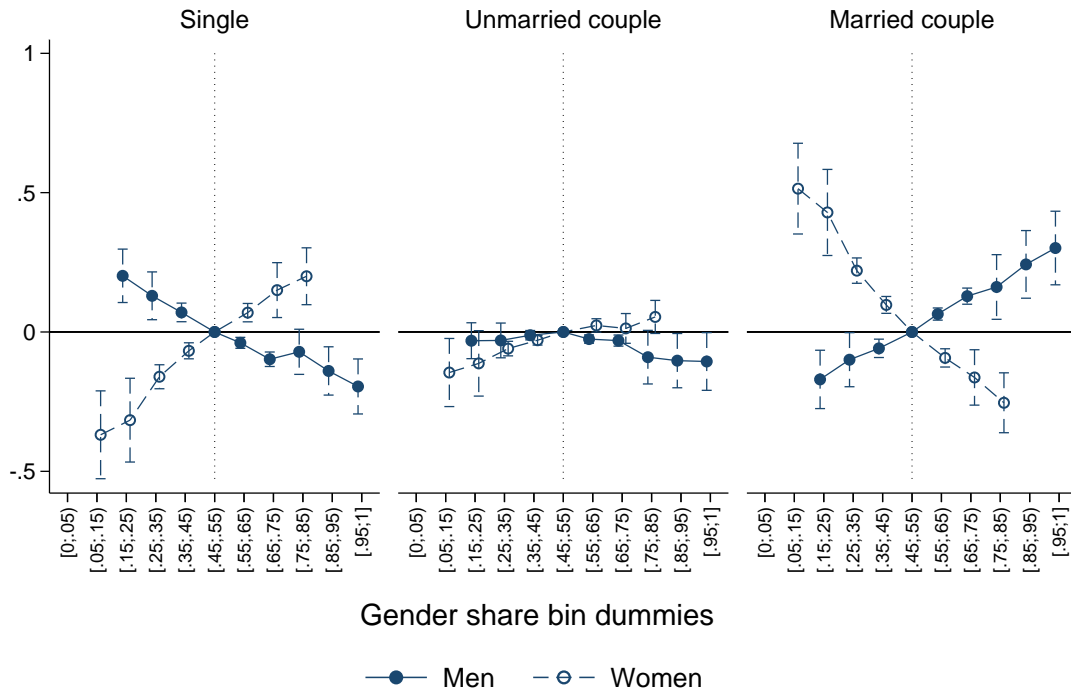


Figure A.4: Non-linear effects of gender share on marital status

Note: This graph shows estimation results for six separate regressions of equation (1) replacing the linear effect of the own-gender share with a series of bin dummies with width 0.1. Each scatter point indicates the point estimate for the respective bin dummy. The omitted category is a gender share between 0.45 and 0.55. The vertical whiskers indicate 95% confidence intervals. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

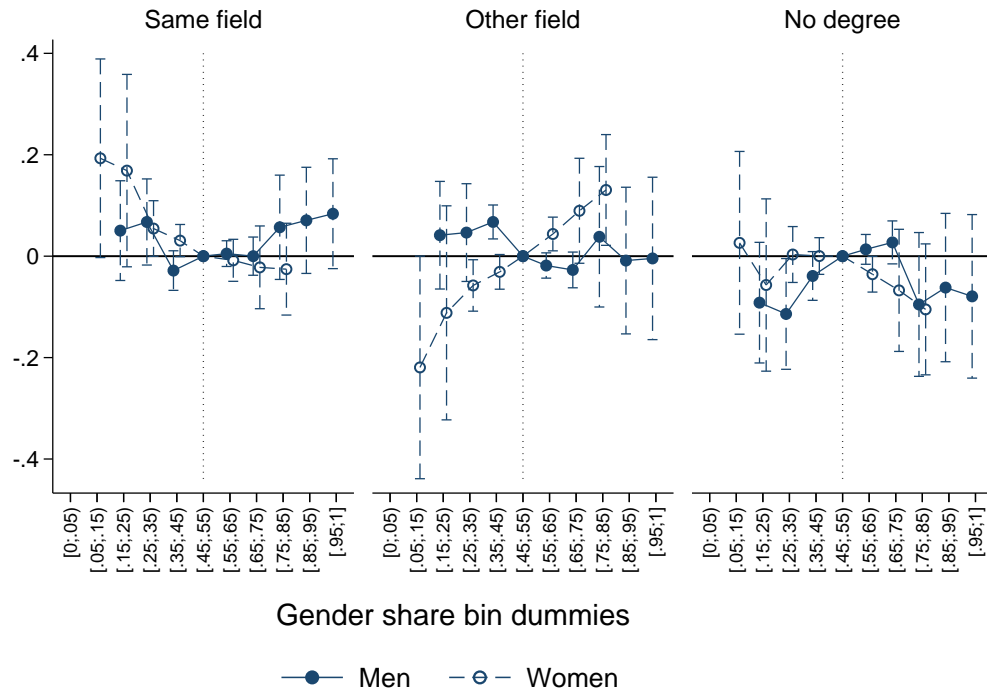


Figure A.5: Non-linear effects of gender share on couple composition

Note: This graph shows estimation results for six separate regressions of equation (1) replacing the linear effect of the own-gender share with a series of bin dummies with width 0.1. Each scatter point indicates the point estimate for the respective bin dummy. The omitted category is a gender share between 0.45 and 0.55. The vertical whiskers indicate 95% confidence intervals. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

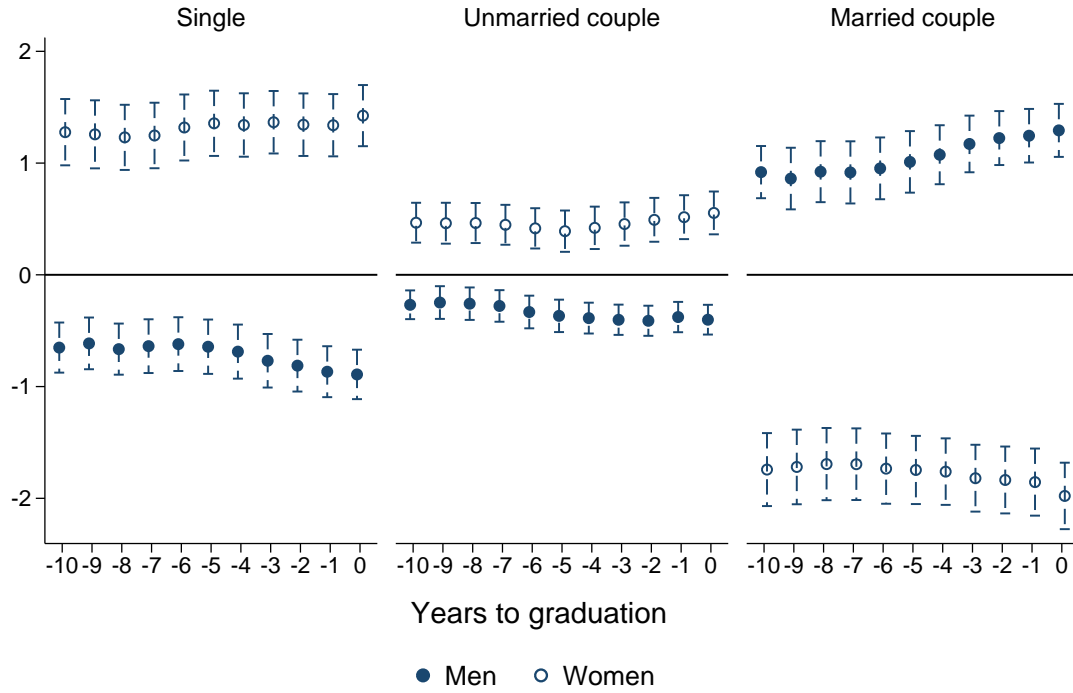


Figure A.6: Effects of gender share on marital status for different lags

Note: This graph shows estimation results for 66 separate regressions of equation (1) for alternative definitions of the field-specific gender composition's timing, employing lags $l \in \{0, \dots, 10\}$ with respect to an individual's year of graduation g . Zero years before graduation is the baseline specification shown in Panel A of Table 2. Each scatter point indicates the respective point estimate for the gender share. The vertical whiskers indicate 95% confidence intervals. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

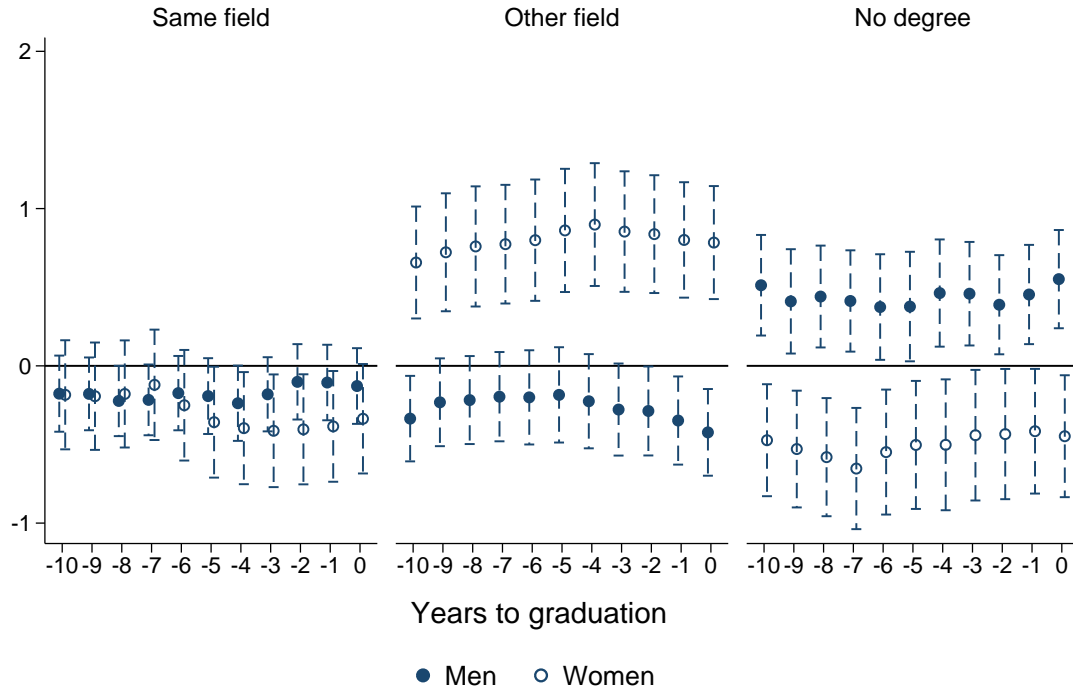


Figure A.7: Effects of gender share on couple composition for different lags

Note: This graph shows estimation results for 66 separate regressions of equation (1) for alternative definitions of the field-specific gender composition's timing, employing lags $l \in \{0, \dots, 10\}$ with respect to an individual's year of graduation g . Zero years before graduation is the baseline specification shown in Panel A of Table 3. Each scatter point indicates the respective point estimate for the gender share. The vertical whiskers indicate 95% confidence intervals. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

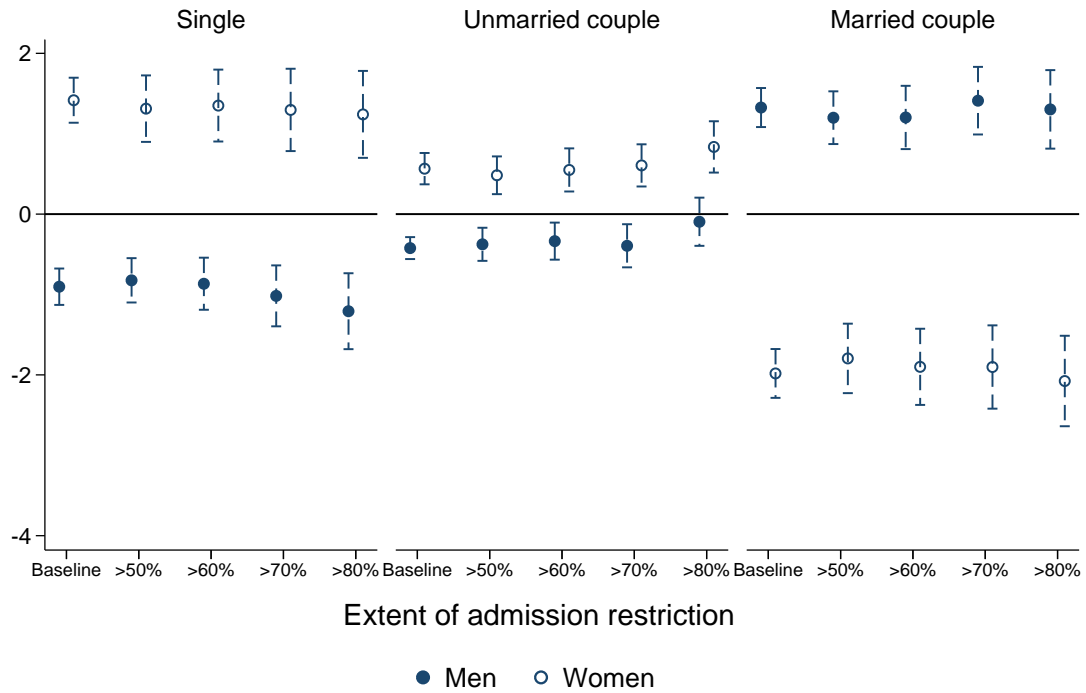


Figure A.8: Effects of gender share on marital status for restricted fields

Note: This graph shows estimation results for 30 separate regressions of equation (1) for alternative sub-samples with respect to the extent of field-specific admission restrictions five years prior to individual graduation. The baseline estimates shows the respective results from Table 2 and can be compared to the estimates for samples of individuals whose field was characterized by a level of admission restriction of more than 50%, 60%, 70% or 80%. Each scatter point indicates the respective point estimate for the gender share. The vertical whiskers indicate 95% confidence intervals. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

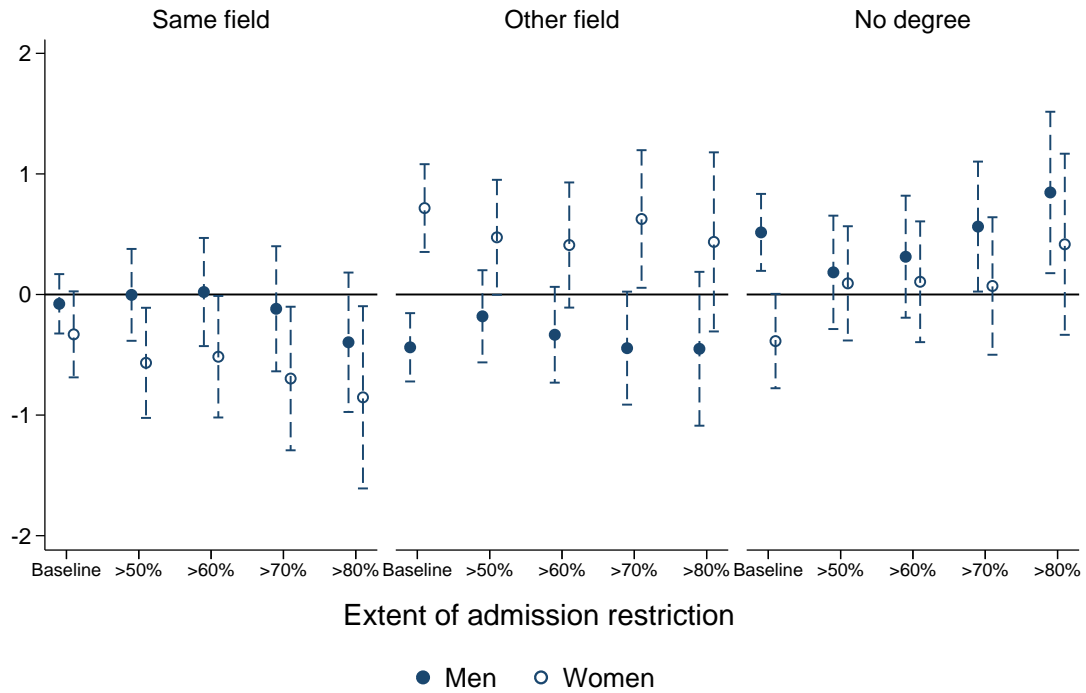


Figure A.9: Effects of gender share on couple composition for restricted fields

Note: This graph shows estimation results for 30 separate regressions of equation (1) for alternative sub-samples with respect to the extent of field-specific admission restrictions five years prior to individual graduation. The baseline estimates shows the respective results from Table 3 and can be compared to the estimates for samples of individuals whose field was characterized by a level of admission restriction of more than 50%, 60%, 70% or 80%. Each scatter point indicates the respective point estimate for the gender share. The vertical whiskers indicate 95% confidence intervals. *Source:* Statistical Yearbooks & Microcensus 2003–2011, own calculations.

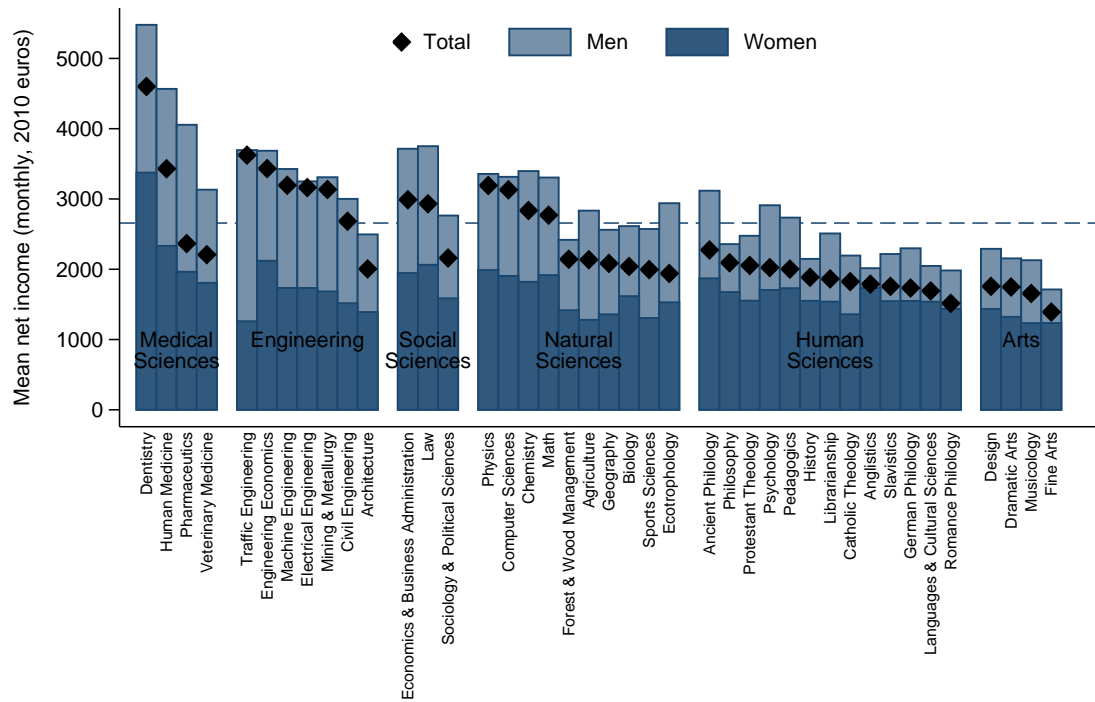


Figure A.10: Average income by field of study

Note: This bar graph shows the mean of individual net income by field of study for all individuals (black diamonds) and by gender separately, where the height of the combined bars gives the average income for men, while the dark bars give the average for women. The horizontal dashed line indicates the overall average income.
Source: Microcensus 2003–2011, own calculations.

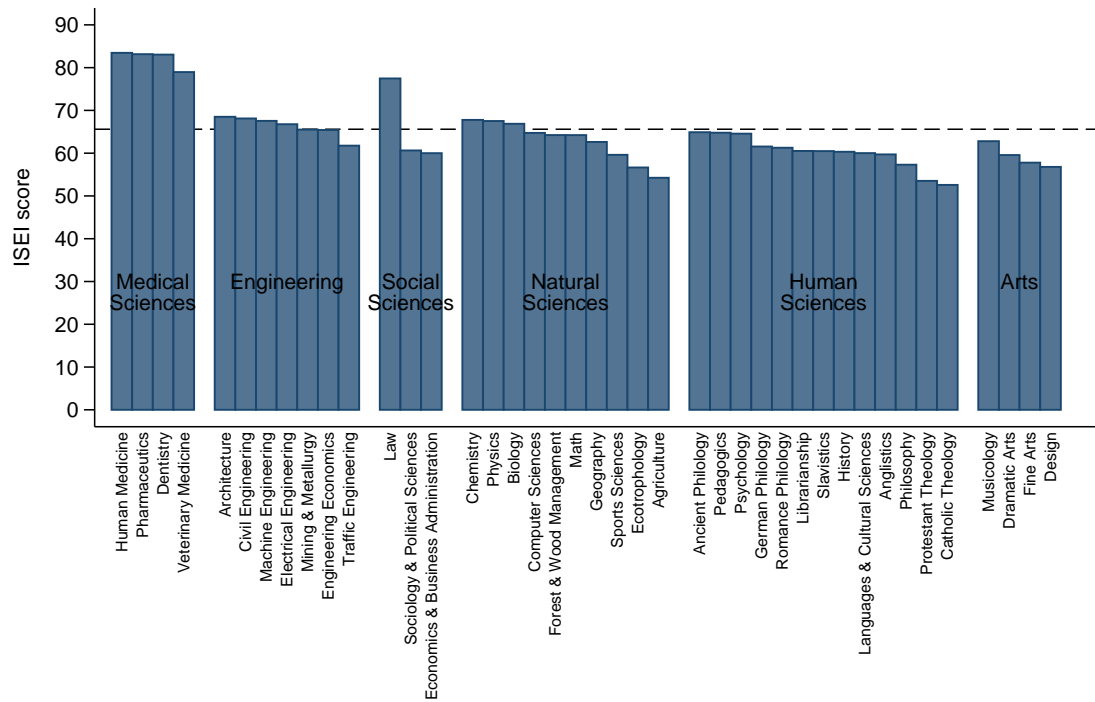


Figure A.11: Average occupational prestige score by field of study

Note: This bar graph shows the mean of individual occupational prestige score of graduates by field of study according to Ganzeboom et al. (1992). The horizontal dashed line indicates the overall average score. *Source:* Microcensus 2003–2011, own calculations.

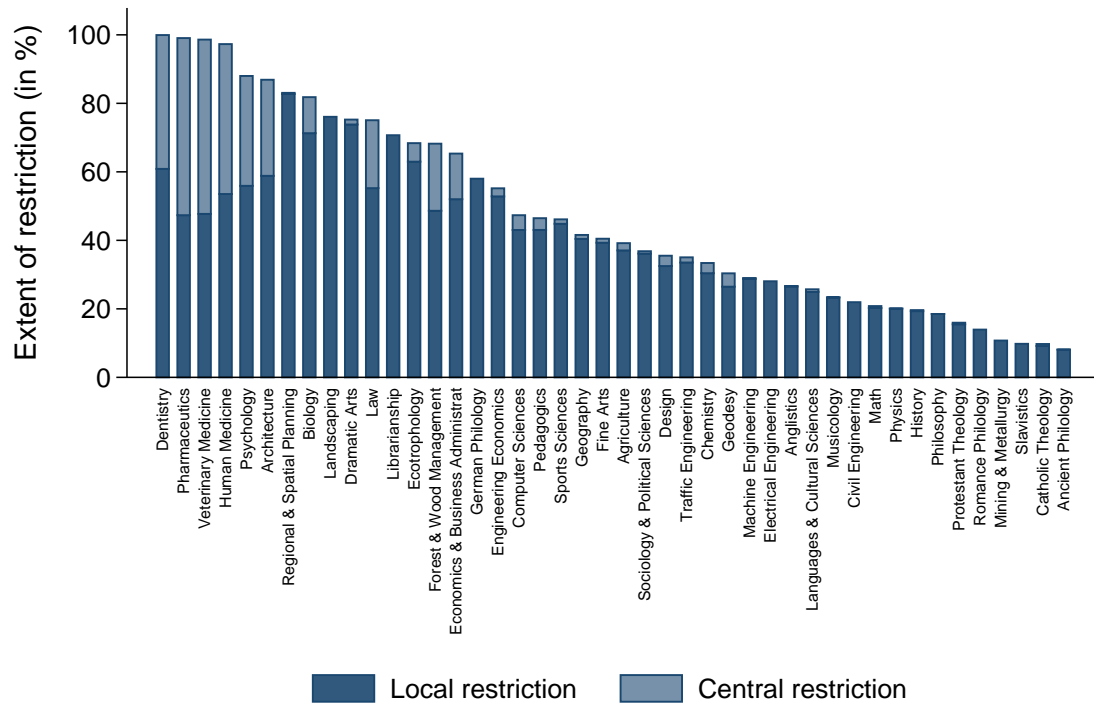


Figure A.12: Average level of admission restriction by field of study

Note: This bar graph shows the mean percentage of German universities where admission to university education is restricted (centrally or locally) over the period 1977–2011 by field of study. *Source:* German Rectors' Conference (*Hochschulrektorenkonferenz*, HRK), own calculations.

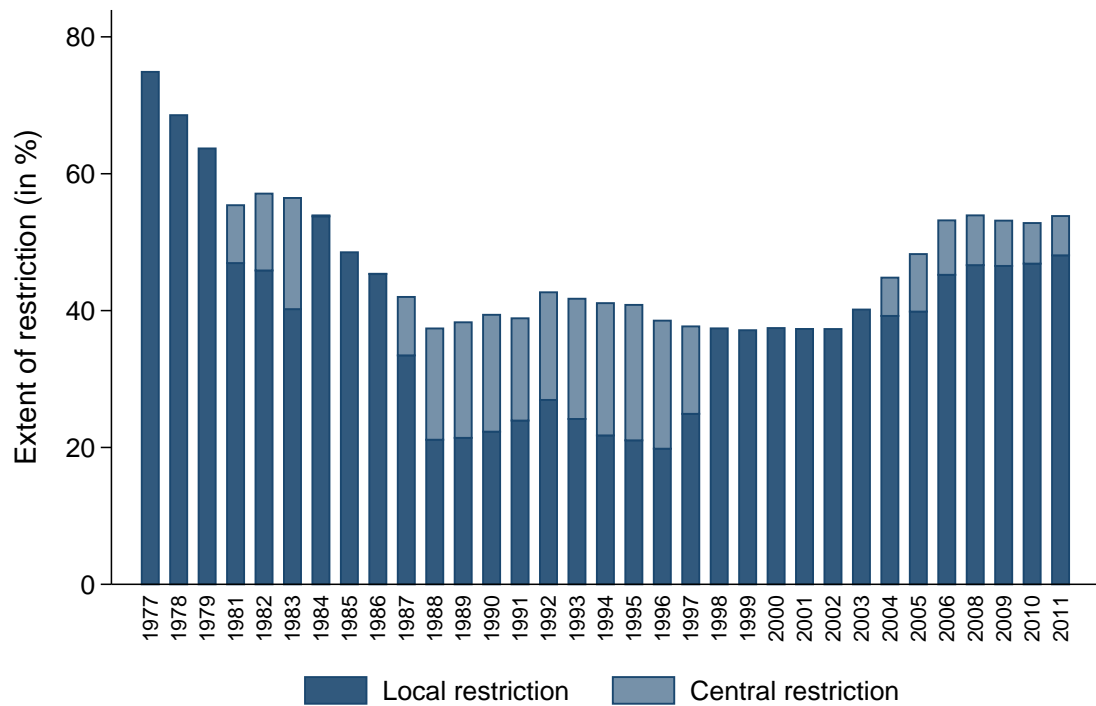


Figure A.13: Average level of admission restriction by year

Note: This bar graph shows the mean percentage of German universities where admission to university education is restricted (centrally or locally) for all fields of study by year. *Source:* German Rectors' Conference (Hochschulrektorenkonferenz, HRK), own calculations.

Table A.1: Summary statistics: Female share by field of study

Field group Field	Female share		Observations		
	Mean	Sd	Men	Women	Total
Social Sciences	.43	.08	14467	11605	26072
Law	.46	.03	2422	2262	4684
Economics and Business Administration	.38	.05	9157	6301	15458
Sociology and Political Sciences	.55	.02	2888	3042	5930
Human Sciences	.69	.09	4582	10896	15478
Languages and Cultural Sciences	.67	.02	96	214	310
Protestant Theology	.53	.05	100	86	186
Catholic Theology	.46	.04	100	78	178
Pedagogics	.73	.03	2710	7336	10046
Philosophy	.4	.02	355	225	580
Psychology	.71	.05	259	711	970
History	.44	.01	272	215	487
Librarianship	.58	.03	197	402	599
Ancient Philology	.55	.03	24	50	74
Anglistics	.71	.01	133	566	699
Romance Philology	.78	.01	22	132	154
Slavistics	.75	.03	92	199	291
German Philology	.73	.03	222	682	904
Natural Sciences	.33	.2	7293	3404	10697
Math	.43	.03	570	358	928
Agriculture	.38	.05	377	258	635
Sports Sciences	.43	.02	226	191	417
Computer Sciences	.14	.02	2816	417	3233
Physics	.14	.03	1074	147	1221
Chemistry	.34	.05	611	334	945
Biology	.57	.03	631	850	1481
Geography	.42	.03	506	323	829
Forest and Wood Management	.2	.06	314	118	432
Ecotrophology	.85	.02	168	408	576
Medical Sciences	.52	.1	2488	2705	5193
Human Medicine	.5	.05	1887	1929	3816
Dentistry	.44	.09	431	292	723
Veterinary Medicine	.74	.08	113	265	378
Pharmaceutics	.7	.03	57	219	276
Engineering	.16	.13	15564	3188	18752
Machine Engineering	.11	.03	6383	1014	7397
Mining and Metallurgy	.12	.05	901	105	1006
Architecture	.46	.04	1414	1122	2536
Civil Engineering	.18	.03	1869	496	2365
Traffic Engineering	.03	0	138	4	142
Electrical Engineering	.04	.01	3735	231	3966
Engineering Economics	.15	.03	1124	216	1340
Arts	.6	.07	955	1342	2297
Fine Arts	.72	.02	175	347	522
Dramatic Arts	.59	.02	124	122	246
Musicology	.53	.02	373	409	782
Design	.59	.02	283	464	747
Total	.41	.22	45349	33140	78489

This table shows the full list of fields of study employed and the numbers of observation of individuals in the microdata holding a degree in the respective field as well as the average female share prevailing in the respective year of graduation. *Source:* Statistical Yearbooks & Microcensus 2003–2010, own calculations.

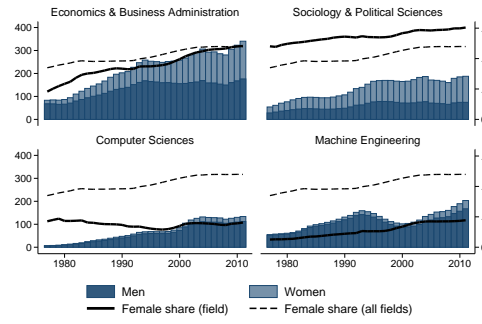


Figure A.14: Fields with more than 100,000 students

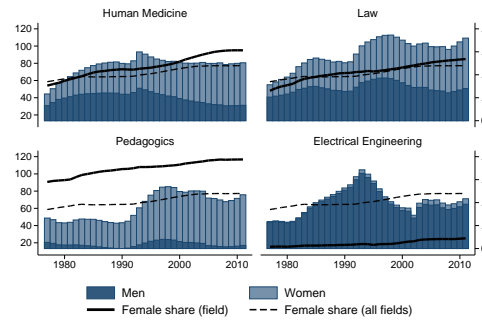


Figure A.15: Fields with up to 100,000 students

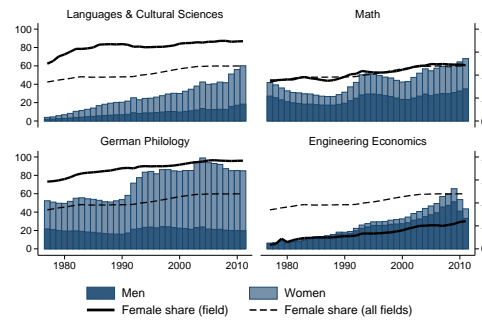


Figure A.16: Fields with up to 80,000 students

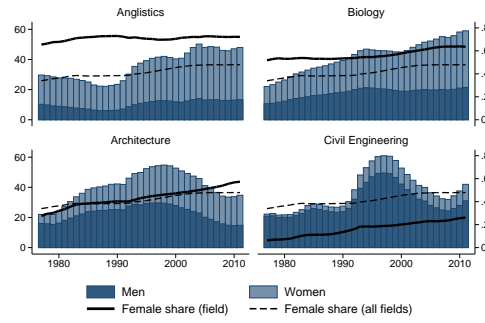


Figure A.17: Fields with up to 60,000 students

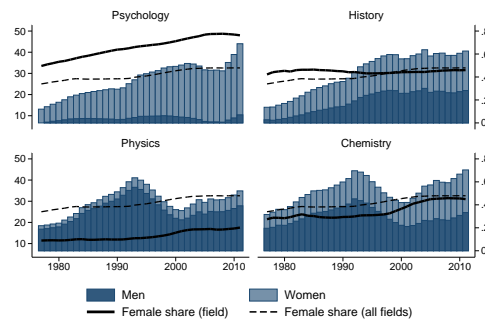


Figure A.18: Fields with up to 50,000 students

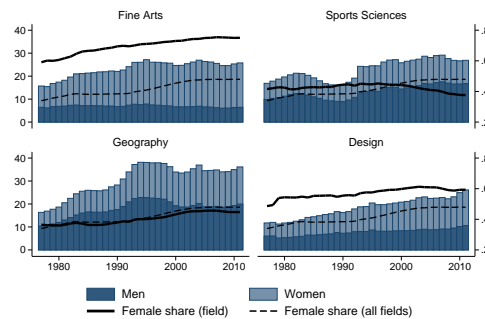


Figure A.19: Fields with up to 40,000 students

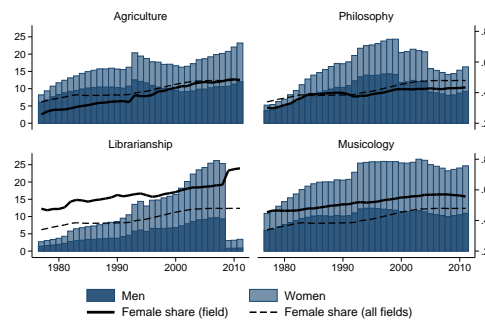


Figure A.20: Fields with up to 25,000 students

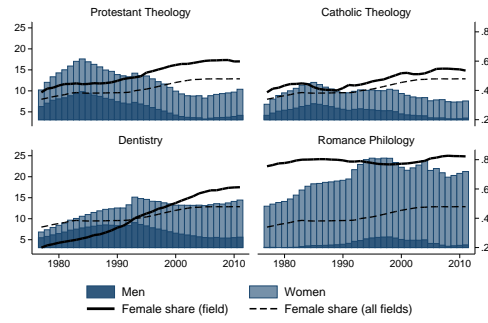


Figure A.21: Fields with up to 20,000 students

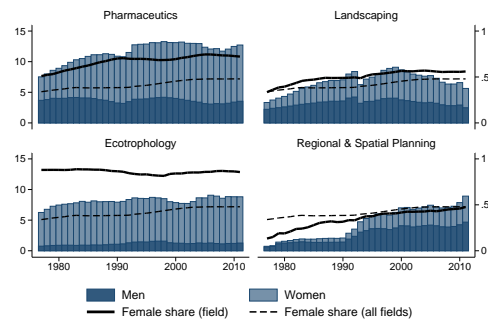


Figure A.22: Fields with up to 15,000 students

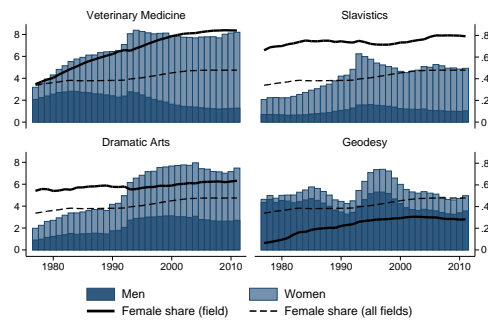


Figure A.23: Fields with up to 10,000 students

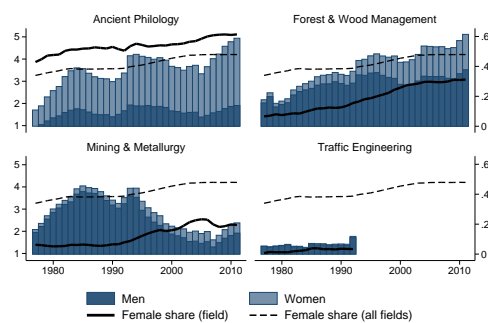


Figure A.24: Fields with up to 5,000 students